What is claimed is:

1. A magnetic resonance imaging apparatus comprising:

a main magnet assembly for generating a main magnetic field in a main magnetic field direction in an examination region;

a gradient coil assembly for generating magnetic gradient fields in the main magnetic field within the examination region;

a radio frequency transmit coil assembly for exciting resonance in selected dipoles within a subject disposed in the examination region such that the dipoles generate circularly polarized resonance signals at a characteristic resonance frequency;

a radio frequency receive coil assembly for receiving the circularly polarized resonance signals generated by the dipoles; and

a reconstruction processor for reconstructing the received signals into an image representation, the radio frequency receive coil assembly being disposed in the examination region substantially perpendicular to the main magnetic field direction and comprising:

a substantially planar substrate; and

an array of quadrature coils disposed on the substrate, each quadrature coil comprising a first loop portion disposed on a first surface of the substrate and a second loop portion disposed on a second surface of the substrate.

2. A magnetic resonance apparatus according to claim 1 wherein the second loop portion comprises an offset from the first loop portion, the offset comprising a displacement in a direction perpendicular to the main magnetic field direction whereby mutual inductance between adjacent quadrature coils in the array is substantially eliminated.

3. A magnetic resonance imaging apparatus according to claim 1 wherein the main magnet assembly comprises a vertical field magnet.

4. A magnetic resonance imaging apparatus according to claim 3 wherein the radio frequency coil assembly comprises a surface coil.

5. A magnetic resonance imaging apparatus according to claim 4 wherein the first and second loop portions are hexagonally shaped.

6. A magnetic resonance imaging apparatus according to claim 1 wherein the first loop portion is capacitively coupled to the second loop portion to form a plurality of coils, each of the plurality of coils being sensitive to radio frequency signals perpendicular to the main magnetic field direction.

7. A magnetic resonance imaging apparatus according to claim 6 wherein the second loop portion comprises a common ground loop.

8. A magnetic resonance imaging apparatus according to claim 1 wherein there is no overlap between adjacent quadrature coils in the array of quadrature coils.

9. A magnetic resonance imaging apparatus according to claim 1 wherein each quadrature coil further comprises at least two takeoff points for taking signals off the quadrature coil and a phase shifter and combiner associated therewith for combining the signals in quadrature.

10. A method of magnetic resonance imaging comprising:

generating a main magnetic field in a main direction in an examination region;

generating magnetic field gradients in the main magnetic field;

transmitting radio frequency signals into the examination region to excite selected dipoles in a subject disposed in the examination region such that the dipoles are circularly polarized in a plane perpendicular to the main direction; and

receiving circularly polarized radio frequency signals from the excited dipoles using a receive coil assembly, the receive coil assembly comprising an array of quadrature coils, each quadrature coil for receiving the radio frequency signals from the circularly polarized dipoles.

11. A method of magnetic resonance imaging according to claim 10 further comprising the steps of:

taking off signals from each quadrature coil from at least two takeoff points;
phase shifting the signals from the at least two takeoff points; and
combining the phase shifted signals in quadrature.

12. A method of magnetic resonance imaging according to claim 10 wherein the step of generating the main magnetic field comprises generating a vertical magnetic field using an open magnet.

13. A method of magnetic resonance imaging according to claim 10 wherein the array of quadrature coils comprises a two dimensional array and the array is disposed in the examination region substantially perpendicular to the main direction.

14. A method of magnetic resonance imaging according to claim 10 wherein each quadrature coil comprises a first loop portion disposed on a first side of a substrate and a second loop portion disposed on a second side of a substrate, opposite the first side, such that there is substantially no mutual inductance between adjacent quadrature coils of the array.

15. A radio frequency receive coil assembly for receiving circularly polarized resonance signals in a magnetic resonance imaging system, the radio frequency receive coil assembly comprising:

a substantially planar substrate; and

an array of quadrature coils disposed on the substrate, each quadrature coil comprising a first loop portion disposed on a first surface of the substrate and a second loop portion disposed on a second surface of the substrate, the second surface being opposite the first surface.

16. A radio frequency receive coil assembly according to claim 15 wherein adjacent quadrature coils in the array are disposed relative to one another such that there is substantially no mutual inductance between the adjacent coils.

17. A radio frequency receive coil assembly according to claim 16 wherein there is no overlap between the adjacent coils.

18. A radio frequency coil assembly according to claim 15 wherein the assembly comprises a surface coil.

19. A radio frequency coil assembly according to claim 18 wherein the array comprises a two-dimensional array and the circularly polarized resonance signals comprise signals in a direction that is parallel to the array.

20. A radio frequency coil assembly according to claim 15 wherein the assembly further comprises a radio frequency transmit coil.